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UNITED STATES PATENT AND TRADEMARK OFFICE

Application No.	:	10/565,875
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Title	:	System & Method for determining attitude using spatial shift key (ssk) modulation signatures
Art Unit	:	3662
Examiner	:	NGUYEN, NGA X

Mail Stop Amendment
Commissioner for Patents
P.O. Box 1450
Alexandria, VA 22313-1450
USA

June 6, 2008

Reply and Amendments in response to restriction requirement imposed in 2nd office communication dated March 21, 2008

Dear Sir/Madam,

1. Background

Receipt of your 2nd Office Communication dated March 21, 2008 regarding restriction requirement under 35 USC 121 and claim rejection under 35 USC 102 for Application No. 10/565,875 is acknowledged.

2. Restriction requirement

The requirement for restriction under 35 USC 121 is traversed. The examiner has broken up current claims 2 - 6, 11 and 19 - 31 into two distinct groups of inventions: Group I consisting of claims 2 - 6 and 11; and Group II consisting of claims 19 - 31. We submit that claims 2 - 6, 11 and 19 - 31 define the one invention. With emphasis on the independent claims we present the following explanation:

The invention defined in claim 2 is directed towards a method of determining attitude, the method comprising the steps of:

> Transmitting a signal through a radiating means and superimposing a cyclic Doppler upon a transmitted signal – There are two cyclic Doppler defined in this claim, the cyclic Doppler superimposed upon the transmitted signal is the first cyclic Doppler mentioned in the claim;
> Receiving the transmitted signal at a receiving means and superimposing a cyclic Doppler upon the received signal – Of the two cyclic Doppler defined in this claim, the cyclic Doppler superimposed upon the received signal is the second cyclic Doppler mentioned in the claim;
> Analysing the relative movement of the receive means to the radiating means by interpreting the cyclic Doppler superimposed upon the received signal.

The invention defined in claim 19 is also directed towards a method for determining attitude, the method comprising the steps of:

> Transmitting a signal through a radiating means such that a first cyclic Doppler is superimposed upon the transmitted signal – This is the first cyclic Doppler generated in this method;
> Receiving the transmitted signal through receiving means such that a second cyclic Doppler is observed by the receiving means – This is the second cyclic Doppler generated in this method;
> Measuring a combined cyclic Doppler, that being a measurement of the combination of the first cyclic Doppler and the second cyclic Doppler (there is no third cyclic Doppler generated);
> Adjusting the receiving means such that the combined Doppler is minimised.

Measuring a combined cyclic Doppler, with the combined cyclic Doppler being a combination of the first and second cyclic Doppler, is not a step of generating a third cyclic Doppler as suggested by the examiner. Therefore, it is submitted that there is no third cyclic Doppler defined in claims 19 – 31 as suggested by the examiner. The combined Doppler is merely an addition of the second cyclic Doppler to the first cyclic Doppler, or in other words, a combination of the first and second cyclic Doppler. To measure this combination cyclic Doppler does not mean to generate a third cyclic Doppler.

We submit that the invention defined in claims 2 – 6 and 11 is not independent or distinct from the invention defined in claims 19 – 31. We submit that there would not be a serious search and examination burden if the claims were to be examined as one invention.

In regard to the classification of the art, class 701 subclass 214 is not relevant to the invention defined in claims 19 – 31. Subclass 214, which is intended under subclass 213, which is intended under subclass 207, which is intended under subclass 200, covers art in the field of data processing for determining course, position or distance travelled employing position determining equipment for indicating the location of a vehicle by using GPS or satellites dedicated to a world wide navigational tracking system with means for improving accuracy of position or location using secondary supplemental means. The invention defined in claims 19 – 31 is directed towards the determination of attitude of a mobile apparatus. In the art of attitude determination, another word for attitude is orientation. The invention defined in claims 19 – 31 is not directed towards determining the position or location of a vehicle. Furthermore, the invention defined in claims 19 – 31 does not use GPS or satellites dedicated to a world wide navigational tracking system.

On the other hand, still on the subject of classification of the art, class 342, subclass 398, which was assigned to the invention defined in claims 2 – 6 and 11, is also relevant to the invention defined in claims 19 – 31. Class 342, subclass 398, which is intended under subclass 386, which is intended under subclass 385, which is intended under subclass 350, covers art in the field of sending or receiving radio wave energy that varies according to the relative direction or position of the sender or receiver, with the signal being directive signals, with a definition of 'directive' being signals that denote course, direction, or orientation, with the subject matter being one or more radiating stations wherein the direction of the beacon radiations is continuously changing. The invention defined in claims 19 – 31 defines a radiating means and a receiving means moving their phase centres through three-dimensional space, which is equivalent to continuously changing the direction of the beacons radiations as described in class 342 subclass 398.

Therefore, it is respectfully submitted that the invention defined in claims 2 – 6 and 11 does not acquire a separate status in the art from the invention defined in claims 19 – 31 in view of their classification; Nor does the subject matter of the invention defined in claims 2 – 6 and 11 diverge from the subject matter of the invention defined in claims 19 – 31; Nor do these groups of claims require a different field of search. Furthermore, for the reasons given above, it is also submitted that the prior art applicable to the invention defined in claims 2 – 6 and 11 would indeed also be applicable to the invention defined in claims 19 – 31; and finally we submit that the invention defined in claims 2 – 6 and 11 would not raise different non-prior art issues from the invention defined in claims 19 – 31.

In accordance with 37 CFR 1.143 and 35 USC 121, we elect Group I of the two groups indicated by the examiner as the invention to be examined. That is to say, claims 2 – 6 and 11 encompass the elected invention to be examined.

3. Claim rejection under 35 USC 102

Rejection of claims 2 – 6 and 11 is now addressed. The examiner rejects the invention defined in claims 2 – 6 and 11 under 35 USC 102(b) as being anticipated by Fenton et al (US 6,128,557 A, priority date September 17, 1998).

Disclosure of Fenton el al

Prior art document US 6,128,557A by Fenton et al discloses a method of overcoming the difficulty in determining position and attitude of a moving space vehicle due to its rotational spin. A GPS antenna placed on the side of a spinning space vehicle will periodically be blocked from reception of a GPS satellite signal due to the space vehicle's body occlusion.

To overcome this constraint, Fenton et al disclose placing two GPS receive antennas on opposite sides of a rotating space vehicle and incorporating a GPS receiver with dual receive paths (one for each antenna). This allows at least one receive antenna to be in view of a GPS satellite signal at all times.

Fig. 2 of Fenton et al discloses deployment of the system described wherein a conventional GPS satellite (25) transmits a ranging signal (21) to the spinning space vehicle (28). The spinning space vehicle (28) incorporates two GPS antennas (20) [20A and 20B] which alternately receive the GPS ranging signal (21).

Fig. 4 of Fenton et al discloses a diagram of a 'receiver logic channel', which is a specialised tracking channel. A receiver logic channel incorporates two processing channels (one for each antenna) and a common tracking loop. The tracking loop includes a Frequency Lock Loop (FLL) discriminator. The FLL discriminator uses the received signal power from the GPS satellite (Fig. 3) to determine which antenna measurement to use at any particular time. When the received signal power from either antenna exceeds a predetermined threshold (T), the measurements from that antenna are used to update the common tracking loop, known as a so called "frequency shift update". When both signals exceed the predetermined signal power threshold (T), the FLL discriminator outputs an average frequency shift. The difference between the average frequency shift and the frequency shift from a particular antenna (processing channel) represents the Doppler shift attributable to the rotational spin of the space vehicle, known as a so called "spin signature".

Difference between claims 2 – 3, 6 and 11 and disclosure of Fenton et al

In regard to claims 2 – 3, 6 and 11, we submit that Fenton et al do not disclose *Transmitting a signal through a radiating means which moves pre-determinately through three-dimensional space, such that a cyclic Doppler is superimposed upon the transmitted signal.*

In the Figure and passage of Fenton et al cited by the examiner (Fig. 2 and column 3, lines 3-15), a conventional GPS satellite (25) transmits a conventional GPS pseudorange (21) to a receiving spinning space vehicle (28). In other words, the satellite (25) is the transmitting device while the spinning space vehicle (28) is the receiving device. With this in mind, we submit that conventional GPS satellites do not spin, and hence they do not impose a cyclic Doppler upon their transmitted signals. Fenton et al do not teach, show or suggest that the GPS satellites spin, nor move pre-determinately through three-dimensional space to create a cyclic Doppler upon their transmitted signal.

We further submit that Fenton et al do not disclose *Adjusting the movement of the receiving means to bring the cyclic Doppler superimposed upon the received signal to a predetermined value.*

In the passage of Fenton et al cited by the examiner (column 3-4, lines 59-10), a so called "FLL discriminator" provides a means to track a GPS satellite signal from a spinning space vehicle. Fenton et al do not teach, show or suggest the adjustment of the GPS antennas on the space vehicle to bring the cyclic Doppler superimposed upon the received signal to a predetermined

value. To do so would require the physical displacement of the space vehicle GPS antenna, or the adjustment of the space vehicle's motion, neither of which is provided for by Fenton et al.

We further submit that Fenton et al do not disclose
Determining the attitude of the receiving means based upon the adjustment required.

In the passage of Fenton et al cited by the examiner (column 4, lines 21-31), vehicle attitude and rotational rate is being determined from the spin signature. This is not the equivalent to physical adjustment of the receiving means. In other words, this is not equivalent to the physical adjustment of the GPS antenna on the space vehicle to allow for the determination of attitude.

Difference between claim 4 and disclosure of Fenton et al

In regard to claim 4, we submit that Fenton et al do not disclose
The predetermined value [of adjustment] to be a minimum.

In the passage of Fenton et al cited by the examiner (column 4, lines 11-20), the Doppler shift component is at a minimum when one GPS antenna is at its closest point to the GPS satellite and is travelling perpendicular to the GPS signal instead of travelling towards or away from the GPS signal. In Fenton et al, an FLL discriminator selects a frequency shift update for an unblocked channel. At this point, there is no requirement for any corrections to the frequency shift update because the Doppler shift component due to vehicle rotation is minimal at this orientation. This is not equivalent to adjusting the movement of a receiving means such that the cyclic Doppler superimposed upon a received signal is minimised. Please refer to the meaning of 'adjusting the movement of a receiving means' in the explanation given under the previous section directly above.

Difference between claim 5 and disclosure of Fenton et al

In regard to claim 5, we submit that Fenton et al do not disclose
The pre-determinate movement of the receiving means to be a replica of the pre-determinate movement of the radiating means.

In the passage of Fenton et al cited by the examiner (column 4, lines 41-52), the spin signature is modelled by:

a) Computing a best sine wave fit to the data;
b) Performing zero crossing detection on the spin signature to determine space vehicle rotational rate;
c) Observing spin signature amplitude to determine space vehicle attitude;
d) Observing spin signature from four or more GPS satellites and applying a least square approach to compute space vehicle orientation.

Fenton et al do not teach, show or suggest that any GPS signal satellite movement is a replica of any space vehicle movement or spinning motion.

In light of the explanation given above, we kindly request reconsideration of the validity of claims 2 – 6 and 11 under 35 USC 102(b) when compared against the disclosure of Fenton et al.

Yours sincerely,

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